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Examining the Relations between Emotions, Motivation, Classroom Engagement and Achievement in Mathematics

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Abstract

The purpose of this correlational research was to examine the relationship between achievement emotions, motivation, and classroom engagement in mathematics among Turkish middle school students, and to determine how these three variables predicted academic achievement in mathematics. 549 seventh grade students in a province located in the south-west region of Turkey participated in the study. Relations among variables were examined by utilizing structural equation modeling. Results of this study provided evidence for the theoretical model that explained the relations between achievement emotions, motivation and classroom engagement and their contributions to a significant amount of mathematic achievement in Turkish contexts. In addition, it was found that the contributions of achievement emotions to engagement depend on whether they were activity- and outcome-focused or deactivating and activating emotions.

Introduction

Mathematics is a fundamental to the students' learning other disciplines (e.g. science) and has importance on their future career success (Gaspard et al., 2015; Seaton, Parker, Marsh, Craven, & Yeung, 2014). However, one issue in mathematics education is that students' interest, motivation and academic achievement is decreasing (Bobis, Way, Anderson & Martin, 2016). According to the 2021 Transition from Primary to Secondary Education (TPSE) test in Turkey (Ministry of National Education [MNE], 2020a), for instance, students had the lowest score in mathematics among other subjects. Furthermore, according to the results of 2019 TIMSS, eighth grade Turkish students' average mathematics score was the 20th in 39 countries. These results indicate that Turkish students' mathematics competence is not at the satisfactory level across the world (MNE, 2020b). Therefore, it is important to examine the factors that may be related to academic achievement in mathematics in Turkey.

Along with dissatisfactory academic achievement score, another issue that mathematics educators struggle is student engagement in mathematics classroom (Bobis et al., 2016). Classroom engagement is an important variable relating to students' achievement and involves students' achievement emotions and behaviors (Acelajado, 2011; National Research Council [NRC], 2007). Engaging students in classroom activities plays an important role on improving desired learning outcomes (Heng, 2014). However, little research on the student

engagement has been done in Turkish contexts, which especially suffer from large class size that hinders student engagement (Ko, Park, Yu, Kim & Kim, 2016). Therefore, we believe it is worth examining the factors that contribute to students' classroom engagement in mathematics to promote the efforts to improve educational outcomes.

Researchers have paid attention to achievement emotions besides the issue of classroom engagement in the last decades. Achievement emotions contribute to students' motivation and achievement in classrooms (Pekrun, 2006; Weiner, 2010). Since achievement emotions are a new area in educational research, there are only few studies addressing students' achievement emotions and related variables in the Asian contexts. We have not located any study addressing achievement emotions in Turkish contexts. Therefore, to fully understand the role of achievement emotions in classroom engagement, it is important to examine the relations amongst achievement emotions, motivation and achievement in mathematics with Turkish middle students. The purpose of this research is to examine the relationship between achievement emotions, motivation, and student engagement in mathematics among Turkish middle school students, and to determine how these three variables predict academic achievement in mathematics.

Classroom Engagement and Achievement

Classroom engagement refers to the process of learning that students actively participate in classroom activities. Classroom engagement includes cognitive, affective and behavioral components (Wang, Bergin, & Bergin, 2014). Affective engagement states students' enjoyment, interest, and excitement. Cognitive engagement expresses students' use of cognitive skills and meta-cognitively active participation (Skinner, Kindermann, & Furrer, 2009). Behavioral engagement states students' participation to learning activities that can be observed (Wang, Bergin & Bergin, 2014). These components mutually influence each other and are embedded into social and individual factors. Classroom engagement is positively related to students' academic achievement; that is to say, the more the students engage in the classroom activities, the higher their achievement score in mathematics they obtain (Leon, Medina-Garrido & Nunez, 2017).

Recent studies have investigated the effects of engagement on academic achievement (Heng, 2014), motivation (Wang & Eccles, 2013) and self-efficacy (Guthrie, Klauda & Ho, 2013). Students with high engagement actively participate in the learning activities to gain the desired knowledge and skills whereas those with low engagement are passive and give up when they face challenges in learning (Skinner & Belmont, 1993). Research has showed that engagement is associated with student academic achievement. For instance, Guthrie et al. (2013) investigated the relations between engagement and text comprehension, and found that positive engagement –dedication- were positively related to text comprehension ($\beta = .10, p < .01$) whereas avoidance did negatively ($\beta = -.21, p < .01$). In another study, Putwain, Nicholson, Pekrun, Becker and Symes (2019) showed that engagement was positively associated with student academic achievement ($\beta = .59, p < .001$). Additionally, Bature, Atweh and Oreoluwa (2020) reported that classroom engagement increased students' problem solving skills in mathematics. Evidence from these studies demonstrated that engagement plays an important role in improving students' academic achievement.

Achievement Emotions and Achievement

Achievement emotions are the ones related to academic activities, learning, success and failure outcomes (Shuman & Scherer, 2014). Achievement emotions are complex constructs that include affective, motivational, cognitive, physiological and expressive components (Shuman & Scherer 2014). In the literature, there are two approaches to classifying achievement emotions; discrete approach-classifying emotions as positive and negative- and dimensional approach -classifying emotions as valence and activation-. Pekrun's (2006) control-value theory provides a social-cognitive perspective on achievement emotions. Pekrun (2006) discussed that these two traditional views can be combined to classify achievement emotions based on whether they are related to academic activities or outcomes of these activities. Pekrun's model puts achievement emotions in three dimensions: valence (positive vs. negative), activation level (activating vs. deactivating), and object focus (activity vs. outcomes). Pekrun's model of achievement emotions has guided extensive research on how achievement emotions are related to cognition, affective component and outcomes of learning.

Studies addressing students' achievement emotion have reported that achievement emotions are related to academic achievement (Pekrun et al. 2017), motivation (Schukajlow, Rakoczy & Pekrun, 2017), and motivation and achievement (Bieg et al., 2017; Buff, Reusser, & Dinkelman 2017). Positive achievement emotions (e.g., enjoyment) seem to preserve cognitive resource and focus attention on the academic tasks, on the one hand (Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, 2017). On the other hand, negative achievement emotions (e.g., boredom) seem to lessen attention and cognitive resource (Pekrun, 2017). For instance, Graziano, Reavis, Keane and Calkins (2007) examined that the relations between achievement emotions and achievement with kindergarten school students. Results of their study showed that achievement emotions were associated with academic success and productivity scores.

Motivation and Achievement

Motivation is a complex and multidimensional construct that is related to cognition and learning. Motivation includes personal goals, beliefs and values about a particular course or task. Different terminology and models of motivation (e.g., expectancy-value theories and self-determination theory) are used to explain students' motivation in educational settings. In this study, Eccles' expectancy-value theory was utilized as it was theorized to explain different achievement-related behaviors in mathematics (Wigfield, Tonks & Klauda, 2009). Expectancy-value theory consists of two components. Expectancy refers to beliefs that how well individuals accomplish the upcoming task. Value refers to how individuals see the tasks important. Individuals' values and expectancies are influenced by their ability beliefs, goals (performance or mastery), previous experiences and self-schema (Wigfield & Eccles, 2000). Over forty years, researchers have used motivation to explain how and why learners are motivated or not motivated to accomplish academic tasks. Findings of extensive studies show that motivation is not only important to increase academic performance but also to improve affective and cognitive factors in educational setting (Alpaslan, Yalvac, Loving & Willson, 2016). For instance, Pantziara and Philippou (2015) reported that intrinsic and extrinsic goal orientation were related to students' interest and academic performance in mathematics. Additionally, task value was associated with students' aspiration and

achievement in mathematics (Guo, Marsh, Parker, Morin, & Yeung, 2015). Furthermore, students with high self-efficacy were reported to perceive mathematics useful and be higher achievers (Guthrie et al., 2013).

The Relations between Variables

Pekrun (2009) argued that there are three ways that achievement emotions and motivation are linked. First, motivational impulses are related to interior of the achievement emotions. Secondly, motivational constructs can trigger achievement emotions, and third achievement emotions can influence motivation in turn. In other words, the links between motivation and achievement emotions are reciprocal. Majority of studies addressing the links between achievement emotions and motivation considered motivation as an antecedent of emotions (e. g., Pekrun & Stephens, 2012), few others took achievement emotions as an antecedent of motivation (e.g. Hanin & Van-Nieuwenhoven, 2016). In Pekrun's control-value theory, however, he states that the two main determinants of achievement emotions are control (self-concepts of ability) and value appraisals. In this study, motivation is considered as a deciding factor of achievement emotion to be consistent with the control-value theory and the majority of studies (González, Fernández, & Paoloni, 2017). Research addressing the link between motivation and achievement emotions has showed that mathematics competence belief and values predicted positively enjoyment and pride and negatively anxiety and hopelessness (Frenzel, Pekrun & Goetz, 2007).

Achievement emotions are the response to the social environment (Pekrun, 2009). In the Handbook of Research on Student Engagement, Pekrun and Linnenbrink-Garcia (2012) discuss how achievement emotions and engagement are related and influence the learning outcomes. Pekrun and Linnenbrink-Garcia states that achievement emotions influence three types of engagement and academic achievement. More specifically, for the links between cognitive engagement and achievement emotions, they assert that students' achievement emotions influence the cognitive recourses and memory process they employ. For example, fear of failure distracts attention while studying for an exam. As for the behavioral engagement, Pekrun and Linnenbrink-Garcia claim that achievement emotions allow more extensive effort. For instance, anxiety may signal that one is not taking necessary steps for the goal. For the link between affective engagement and achievement emotions, they assert that achievement emotions, playing an initiating role, can trigger and facilitate action. Pekrun and Linnenbrink-Garcia highlight that engagement plays a mediating role on achievement emotions and academic achievement. Research has provided evidence that students' achievement emotions can influence their engagement and disengagement (e. g., Kahu, Stephens, Leach, & Zepke, 2015).

The Current Study

Students' achievement emotions, motivations, and classroom engagement can play an important role in academic achievement. Classroom engagement depends on students' achievement emotional and motivational states that help them engage in classroom activities (NRC, 2007). Although the links between achievement emotions and engagement have been theoretically well explained, there is a need to test them with data to fully understand the relations between the variables. Most study focused on the link between positive-negative achievement emotions and engagement, which may not describe well the actual links between the two variables

because each achievement emotion has different characteristics (valence or activation; Pekrun & Linnenbrink-Garcia, 2012). Additionally, the links between affective engagement and achievement emotions have been studied less (Pekrun & Linnenbrink-Garcia, 2012). Moreover, little research addressing engagement and achievement emotions has been carried out in Turkey, where students suffer unsatisfactory mathematics scores at TIMSS 2019.

Based on the theories and the previous studies in the literature, a conceptual model was constructed to explain the relations between variables. As seen in Figure 1, we hypothesized that motivation predicts students' achievement emotions. Then, achievement emotions are related to classroom engagement. Lastly, academic achievement is predicted by classroom engagement.

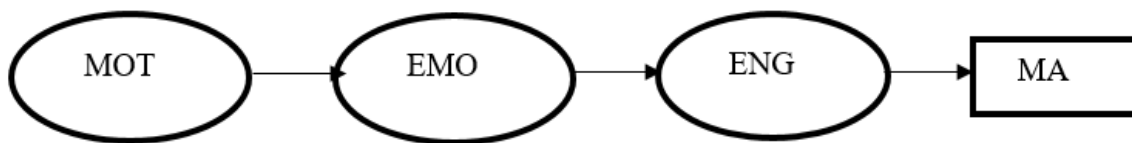


Figure 1. The Hypothesized Model: Note: MOT: Motivation, EMO: Achievement Emotion, ENG: Engagement, MA: Mathematics Achievement

Research Questions

The following research questions were addressed in this study:

1. What proportion of variance in the level of math achievement does the model explain?
2. To what extent do dimensions of motivation including task value, self-efficacy, intrinsic and goal orientation predict directly achievement emotions?
3. To what extent do achievement emotions directly express classroom engagement?
4. To what extent do classroom engagements predict academic achievement?

Method

The present study employed a quantitative correlational research design to address the research questions. Correlational research design is appropriate when the aim of the study is to examine the relations between variables (Karasar, 2017).

Data Collection and Sample

As it is convenient to access, students from six public secondary schools (three in rural area and three in urban area) in a province located in the south-west region of Turkey were selected as the target group of the study. We focused on seventh grade students because they were the closest student group that would enter in the TPSE after eighth graders who were not available because of the TPSE test. Five hundred twenty-five (259 females, 236 males and 30 not reported) seventh grade students who volunteered were involved in the study. Students in the schools were generally middle achievers and came from economically diverse backgrounds. Data were

collected at the end of the spring semester of 2017-2018 academic-year. Questionnaires were administered in their classroom under supervision of the teachers and the students were given 30 minutes to fill in the questionnaires.

Instruments

In this study, we chose the following questionnaires as they are adaptable to the domain of mathematics and appropriately capture the facets of variables.

Motivated Strategies for Learning Questionnaire

The Motivated Strategies for Learning Questionnaire (MSLQ), a 7-point Likert scale, was developed by Pintrich, Smith, Garcia, & McKeachie (1991) to measure motivation in any domain. The MSLQ was validated and used by researchers at the elementary level in Turkey (e.g., Alpaslan, 2017). A short version of the MSLQ including self-efficacy (8 items; a sample item “I believe I will receive an excellent grade in this mathematics class”), task value (6 items; a sample item “It is important for me to learn the course material in this mathematics class”), intrinsic goal orientation (4 items; a sample item “In this mathematics class, I prefer course material that really challenges me so I can learn new things”) and extrinsic goal orientation (4 item; a sample item “Getting a good grade in this mathematics class is the most satisfying thing for me right now”) was used. We adapted the questionnaire to mathematics. The confirmatory factor analysis (CFA) was run to verify the structures and dimensionalities. The results of CFA showed good fit of data, (χ^2 (203, N=525) = 663.44, $p < .01$, SRMR = .034, RMSEA = .054, CFI = .94; Hu & Bentler, 1999). The Cronbach’s Alpha values were from .75 to .85 (See Table 1).

Achievement Emotions Questionnaire

Achievement Emotions Questionnaire (AEQ) was developed by Peixoto, Mata, Monteiro, Sanches, and Pekrun (2015) to measure elementary students’ achievement emotions in mathematics. As a 5-point Likert scale, the AEQ consists of twenty-four items in six dimensions (four items in each dimension) including boredom (a sample item “I get bored during the Math class), hopelessness (a sample item “I have lost all hope of understanding the Math material”), anger (a sample item “After the Math class I am angry”), anxiety (a sample item “I feel nervous in the Math class”), enjoyment (a sample item “I enjoy being in the Math class”) and pride (a sample item “I am proud of the contributions I have made in the Math class”). In this study, the class version of the AEQ-PA was used because we were interested in class engagement. The results of CFA indicated a good fit of data, (χ^2 (237, N=525) = 606.01, $p < .01$, SRMR = .038, RMSEA = .052, CFI = .96; Hu & Bentler, 1999). The Cronbach’s Alpha values were from 0.75 to 0.80 (See Table 1).

Classroom Engagement Inventory

The Classroom Engagement Inventory (CEI) was developed by Wang, Bergin and Bergin (2014) and adapted

into Turkish by Sever (2014) to measure students' classroom engagement. As a 5-point scale, the CEI consists of 23 items in five dimensions including cognitive engagement (7 items; a sample item "In this mathematics class, I go back over things I don't understand"), affective engagement (6 items: a sample item "In this mathematics class, I feel excited"), behavior engagement-compliance (4 items: a sample item "In this mathematics class, I actively participate in class discussions"), behavior engagement-effortful classroom participation (3 items: a sample item "In this mathematics class, I work with other students and we learn from each other") and disengagement (3 items; a sample item "In this mathematics class, I let my mind wander"). The results of the CFA indicated a good fit of data, (χ^2 (220, N=525) =595.30, $p < .01$, SRMR = .041, RMSEA = .058, CFI =.95; Hu & Bentler, 1999). The Cronbach's Alpha values were from 0.75 to 0.88 (See Table 1).

Achievement in Mathematics

The students' final mathematics grade in the semester that the study took place was taken as their achievement score. Students were asked to write out their mathematics grade of the semester. Students' mathematics grade comprised the outcomes of two mid-term examinations, equally-weighted, which all mathematics teachers at the school prepared together. Self-reported achievement score could be problematic because of inflation. Yet, Kuncel, Crede' and Thomas (2005) showed that students' self-report average grade was highly correlated with their actual average grade in mathematics ($r = .84$, 90% credibility interval .72 to .92) . The students' final grades ranged from 1 (failed) to 100 (excellent). The internal consistency of the mathematics achievement score computed by split-half method was .75.

Data Analysis

Data analysis was done in two steps. First, we computed descriptive statistics including mean, standard deviation, skewness and kurtosis. In the second step, we used structural equation modeling (SEM) technique, to address the research questions of the study. SEM is a statistical technique to investigate structural relations, including direct and indirect, in the model (Kline, 2011). To examine the fit of the data with the model, we used the ratio of chi-square (χ^2) to degree of freedom (df), the root mean square error of approximation (RMSEA), the standardized root mean residual (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). In the literature, the cutoff values for good fit is 2.0 or lower for the ratio of χ^2/df , 0.06 or lower for RMSEA, 0.08 or lower for SRMR, 0.95 or higher for CFI and TLI (Hu & Bentler, 1999). All analysis was done in the MPLUS 6 software.

Results

Mean, standard deviation, Cronbach's alpha and bivariate correlation among variables were presented in Table 1. For motivation scales, mean scores were between 3.48 to 5.06, for academic emotion scales from 1.93 to 4.26, and for classroom engagement scales from 2.64 to 3.79. Mean score for mathematics achievement was 64.56 out of 100. In motivation scales, students reported the lowest mean value in extrinsic goal orientation whereas task value was the highest one. Among academic emotions, anger had the lowest mean score whereas

pride did the highest one. In classroom engagement scales, the lowest mean score belonged to disengagement scale whereas behavior engagement-compliance was the highest one. The magnitude of bivariate correlation ranged from .01 to .54. Among the variables, all were statistically significant except those were between motivational constructs and disengagement. Motivation scales were positively correlated with positive achievement emotions and negatively correlated with negative emotions. Similarly, the correlations between negative and positive achievement emotions were negative. Likewise, the correlations between negative achievement emotions and classroom engagement were negative and others were positive.

Table 1. Mean, Standard Deviation, Cronbach's Alpha and Bivariate Correlation among Variables

	MA ^a	TV	SELF	IGO	EGO	PRI	HOP	ENJ	BOR	ANX	ANG	DE	CE	BEE	BEC	AE	
TV ^b	.17*																
SELF _b	.14*	.50*															
IGO ^b	.10*	.42*	.56*														
EGO _b	.11*	.52*	.47*	.40*													
PRI ^c	.16*	.44*	.41*	.43*	.34*												
HOP _c	-.13*	.42*	-.47*	.41*	-.29*	.35*											
ENJ ^c	.18*	.48*	.46*	.45*	.35*	.54*	-.35*										
BOR _c	-.11*	.41*	-.46*	.41*	-.25*	.34*	.50*	-.32*									
ANX _c	-.09	.34*	-.40*	.31*	-.19*	.25*	.36*	.28*	.42*								
ANG _c	-.17*	.34*	-.37*	.34*	-.26*	.29*	.54*	.26*	.47*	.55*							
DE _c	-.04	-.05	.01	-.04	-.01	.09*	.14*	.14*	.14*	.05	.12*						
CE _c	.16*	.38*	.32*	.46*	.42*	.39*	-.33*	.39*	-.42*	-.35*	-.28*	.16*					
BEE _c	.28*	.45*	.49*	.49*	.45*	.36*	-.35*	.37*	-.40*	-.33*	-.27*	.12*	.46*				
BEC _c	.12*	.42*	.43*	.39*	.45*	.40*	-.38*	.42*	-.43*	-.36*	-.32*	-.02	.36*	.40*			
AE _c	.17*	.52*	.35*	.45*	.49*	.41*	-.41*	.46*	-.49*	-.43*	-.35*	.08	.47*	.49*	.50*		
M	64.56	5.06	4.82	4.97	3.48	4.26	1.95	3.4	1.97	2.34	1.93	2.64	3.56	3.56	3.79	3.47	
SD	19.49	1.71	1.69	1.68	1.21	1.63	0.99	1.16	0.97	1.03	0.99	1.33	1.03	1.09	1.08	1.09	
α	.75 ^d	.84	.85	.81	.75	.80	.77	.75	.79	.77	.78	.83	.88	.75	.76	.82	

^a : 100 point scale ^b :7-point scale, ^c: 5- point scale, ^d Computed by split-half methods, * p < .05 MA: Mathematics achievement, TV: Task value, SELF: Self-efficacy, IGO: Intrinsic goal orientation, EGO: Extrinsic goal orientation, PRI: Pride, HOP: Hopelessness, ENJ: Enjoyment, BOR: Boredom, ANG: Anger, ANX: Anxiety, DE: Disengagement, CE: Cognitive engagement, BEE: Behavior engagement-effortful, BEC: Behavior engagement-compliance, AE: Affective engagement,

SEM was run in MPLUS 6.12 statistical package program. The results of SEM were (χ^2 (2207, N=525) =5501.60, p<.01, SRMR =.049, RMSEA =.053, CFI =.94). The ratio of chi-square to degree of freedom (2.49) was higher than 2.00. However, chi-square value might be misleading since it is sensible to the sample size. RMSEA value was lower than .06 cutoff value for good fit (Hu & Bentler, 1999). In addition to this, the CFI

value was close to the .95 cutoff value (Hu & Bentler, 1999). Given the recommended cutoff value for good fit in the literature, the results of SEM showed that the model was in good fit with the data obtained in Turkish middle school students.

Regarding the first research question, the SEM results showed that the hypothesized model explained 30% variance in students' mathematics achievement. This result is important as 30 % of variance in academic achievement could be accounted by motivation, achievement emotions and classroom engagement. In addition, the model explained a significant amount of variance in classroom engagement variables: namely, 11% in disengagement, 40 % in cognitive engagement, 41% in behavior engagement-effortful, 41% behavior engagement-compliance and 50% in affective engagement. The model also explained a significant amount of variance in academic emotions; to name it, 30 % in pride, 64% in hopeless, 36% in enjoyment, 53% in boring, 61% in anxiety and 66% in anger.

The second research question was related to the prediction of motivational constructs to academic emotions. Examinations of path coefficients revealed that some path coefficients were statistically significant whereas others were not. Path coefficients between achievement emotions and motivational constructs were displayed in Table 3. Task value statistically significantly and positively predicted pride ($\beta = .34, p < .01$) and enjoyment ($\beta = .39, p < .01$) whereas negatively hopelessness ($\beta = -.27, p < .01$), and boredom ($\beta = -.42, p < .01$). Self-efficacy was statistically significantly associated with positive achievement emotions including pride ($\beta = .22, p < .01$) and enjoyment ($\beta = .19, p < .01$). Goal orientations of students were statistically significantly related to students' academic emotions. Intrinsic goal orientation was positively associated with enjoyment ($\beta = .37, p < .01$) and negatively with boredom ($\beta = -.33, p < .01$). Extrinsic goal orientation was statistically significantly related to anxiety ($\beta = .22, p < .01$) and anger ($\beta = -.25, p < .01$).

Table 2. Path Coefficients between Achievement Emotions and Motivational Constructs

Variables	PRI	HOP	ENJ	BOR	ANX	ANG
TV	.34*	-.27*	.39*	-.42*	-.09	-.26*
SELF	.22*	-.05	.19*	-.10	-.08	-.06
IGO	.10	-.08	.37*	-.33*	-.04	-.11
EGO	.02	-.05	.24	-.03	.22*	-.25*

* $p < .05$

As for the third and fourth research questions, the results of CFA showed statistically significant relations between academic emotions, classroom engagement and mathematics achievement. According to results presented in Table 3, pride was positively related to affective engagement ($\beta = .23, p < .01$), behavior engagement-compliance ($\beta = .32, p < .01$), behavior engagement-effortful ($\beta = .24, p < .01$) and negatively to disengagement ($\beta = -.19, p < .01$). Enjoyment significantly predicted disengagement ($\beta = -.17, p < .01$), cognitive engagement ($\beta = .19, p < .01$), affective engagement ($\beta = .49, p < .01$), behavior engagement-compliance ($\beta = .35, p < .01$) and behavior engagement-effortful ($\beta = .38, p < .01$). Among negative emotions, hopelessness and boredom were significantly related to disengagement ($\beta = .32$ and $\beta = -.22$ respectively, $p < .01$), affective

engagement ($\beta = -.23$ and $\beta = -.45$ respectively, $p < .01$) and behavior engagement-effortful ($\beta = -.21$ and $\beta = -.26$ respectively, $p < .01$), and behavior engagement-compliance ($\beta = -.27$ and $\beta = -.18$ respectively, $p < .01$). Similarly, anxiety and anger were associated with cognitive engagement ($\beta = -.28$ and $\beta = -.21$ respectively, $p < .01$), affective engagement ($\beta = -.33$ and $\beta = -.39$ respectively, $p < .01$), behavior engagement-compliance ($\beta = -.22$ and $\beta = -.29$ respectively, $p < .01$) and behavior engagement-effortful ($\beta = -.18$ and $\beta = -.23$ respectively, $p < .01$). Finally, analysis revealed that all classroom engagement scales were statistically significantly related to mathematical achievement (for disengagement $\beta = -.11$, for cognitive engagement $\beta = .39$, for affective engagement $\beta = .31$, for behavior engagement-compliance $\beta = .29$ and for behavior engagement-effortful $\beta = .24$).

Table 3. Path Coefficients between Achievement Emotions, Classroom Engagement and Mathematics Achievement

Variables	Achievement					
	DE	CE	BEE	BEC	AE	MA
PRI	-.19*	.09	.24*	.32*	.23*	
HOP	.32*	-.04	-.26*	-.27*	-.23*	
ENJ	-.17*	.19*	.38*	.35*	.46*	
BOR	.22*	-.09	-.21*	-.18*	-.45*	
ANX	.09	-.28*	-.18*	-.22*	-.33*	
ANG	.11	-.21*	-.23*	-.29*	-.39*	
DE						-.11*
CE						.39*
BEE						.24*
BEC						.29*
AE						.31*

* $p < .05$

Discussion

In this study, the relations between motivation, achievement emotions and classroom engagement and how these relations contributed to mathematical achievement were examined. Results of this study provided evidence for a theoretical model that explained the relations between achievement emotions, motivation and classroom engagement and their contributions to mathematic achievement in Turkish contexts. Additionally, analysis revealed that relations amongst motivation, achievement emotions and classroom engagement could be accounted for 30% variance in mathematics achievement. Despite of the fact that the amount of variance explained was moderate, this amount was very important since the model did not include other important variables on academic achievement that the literature underscored (e.g., self-regulation, learning strategies, attitudes etc.). This would provide valuable information for policy makers in Turkey regarding how to make students more engaged in classroom activities and increase their academic achievement in mathematics.

Consistent with the previous studies in the field, the results of this study suggest that motivational constructs including self-efficacy, task value, intrinsic and extrinsic goal orientations predict achievement emotions. As

previously mentioned, Pekrun (2009) described the three ways that emotions and motivation are connected. The one is that motivational impulses include interior of the emotions whereas the second is motivational constructs can activate emotions. Lastly, emotions can influence motivation. Results of this study provide evidence for the second way which motivation can precede emotions. More specifically, a higher task value resulted in a lower hopelessness, boredom and anger but gave a higher enjoyment and pride in mathematics. In this study, self-efficacy was found statistically significant only to pride and enjoyment. Although this was not tested in this study, that finding could provide evidence for the third way because one of sources for self-efficacy is the successful experience (Bandura, 2003). Completing successfully a mathematical task would provide students pride and enjoyment, and then, this could increase self-efficacy in mathematics.

One important finding of this study was that intrinsic goal orientation seemed to be related to positive (pride) and negative (boredom) academic emotions. Of these emotions, enjoyment is an activity-focused activating emotion whereas boredom is an activity-focused deactivating emotion (Pekrun, 2009). This result is plausible because intrinsic goal orientation refers to students' goals regarding curiosity and mastery in an academic task. Therefore, students' curiosity and mastery will seem to lead them to experience activity-focused emotions. Similarly, since extrinsic goal orientation refers to students' goals regarding performance, it was related to only outcome-focused activating emotions (anger and anxiety).

Another important finding of this study is to further our understanding of specific emotions and motivations by involving classroom engagements into the model. The previous studies on emotions have mostly examined their relations to student engagements from the point of view of positive and negative emotions (Linnenbrink-Garcia, Rogat, & Koskey, 2011). However, Pekrun and Linnenbrink-Garcia (2012) argued that one problem on such a view was that each positive or negative emotion could have different kinds of effects on student engagement. For instance, both anxiety and hopelessness are negative emotions but the former is activating but the latter is deactivating emotion. Therefore, Pekrun and Linnenbrink-Garcia (2012) underscored that it might be misrepresentative to use both emotions the same in learning and academic achievement. Results of this study indicate that amongst negative emotions, deactivating achievement emotions were statistically significantly related to students' classroom disengagement in mathematics while activating ones were not. For instance, hopelessness was found to be positively associated with disengagement ($\beta = .32$) whereas anxiety was not statistically significant ($\beta = .09$). This finding provides evidence for Pekrun and Linnenbrink-Garcia's (2012) argument that classifying emotions as negative and positive would not be enough to describe the effects of emotions on students' learning in classroom.

Conclusions

Overall, the results of this study suggest that motivation and emotion does not only support each other alone but also influence other variables including classroom engagement and academic emotions; thus, teachers should care about students' achievement emotions and increase students' enjoyment and pride. In this study it was found that emotions played the role of a bridge between motivation and classroom engagement. More specifically, it was found that when students felt themselves self-efficacious, they were proud of their success

and enjoyed being in the mathematics classroom, and then, they engaged in the mathematics course cognitively, affectively and behaviorally. Although the tested relations in this study were pictured as one-way, it should be noted that theories of motivation, emotion and engagement emphasize the relations among these constructs were reciprocal. In other words, positive emotions could influence students' self-efficacy and similarly proper engagement could increase their emotions and self-efficacy.

One important implication that the findings of this study suggests is that relations between emotion and classroom engagement are important for increasing students' mathematical achievement in Turkey. Providing enjoyable classroom activities for the students will potentially increase their engagement and academic achievement. School mathematics activities are often described as solving teacher-selected problems in a matter of minutes (Beswick, 2012; Burton, 2002). Typically, learning mathematics is depicted as studying on the textbook and getting the right answer (Beswick, 2012). Such classroom activities have potential to create an isolated environment for learning. This undermines situated learning which underscores the importance of constructing the meaning with social interaction. Having positive and activating emotions such as enjoyment and pride would increase students' engagement cognitively, affectively and behaviorally. One example of such teaching methods is creative drama. The creative drama method makes the course interesting and allows students to participate and learn by doing and experiencing the fun and help them develop their math skills (Bronson, 2012; Erdogan & Baran, 2008; Kirkland, 2013; Ulubey & Gozutok, 2015). Additionally, the literature showed evidence that creative drama method reduces students' fears about mathematics, increases interest in the course and develops positive attitudes towards mathematics (Ceylan, 2014; Fleming, Merrell & Tymms, 2004).

Another method that would potentially have a positive effect on students' achievement and attitudes towards mathematics is game-based instruction. Studies reported that mathematics activities, implemented by using three dimensional play, had a positive effect on students' success, motivation for the course and their mathematics achievement (Bai, Pan, Hirumi, & Kebritchi, 2012; Kebritchi, 2008; Shin, Sutherland, Norris, & Soloway, 2012). Given the effects of creative drama and game-based instruction, more emphasis should be given to these types instruction in mathematics curriculum and teachers should be encouraged to use them as well.

This study has certain limitations. First, culture influences the variables in the model. Thus, the model may not neatly give the same relations in other countries. Second, the domain also may affect the strength of the relationship since students may have different motivation and emotions across domains. The conceptual model can be expended by adding other variables including learning strategies to explain more variance in mathematical achievements. Lastly, models with social contexts variables should be examined by further research in emotion; for instance, the influence of social support on emotion and motivation can be examined to fully understand the nature of emotions.

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